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APPLICATION FOR LETTERS PATENT

**Systems and Methods for Personalized Karaoke**

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1            **RELATED APPLICATIONS**

2            [0001] This patent application is related to:

3            [0002] U.S. patent application serial no. 09/882,787, titled “A Method and  
4            Apparatus for Shot Detection”, filed on 06/14/2001, commonly assigned herewith,  
5            and hereby incorporated by reference.

6            [0003] U.S. patent application serial no. \_\_\_\_\_, titled “Systems and  
7            Methods for Generating a Comprehensive User Attention Model”, filed on  
8            November 01, 2002, commonly assigned herewith, and hereby incorporated by  
9            reference.

10          [0004] This patent application is related to U.S. patent application serial no.  
11          10/286,348, titled “Systems and Methods for Automatically Editing a Video”, filed  
12          on 11/01/2002, commonly assigned herewith, and hereby incorporated by  
13          reference.

14          [0005] This patent application is related to U.S. patent application serial no.  
15          10/610,105, titled “Content-Based Dynamic Photo-to-Video Methods and  
16          Apparatuses”, filed on 06/30/2003, commonly assigned herewith, and hereby  
17          incorporated by reference.

18          [0006] This patent application is related to U.S. patent application serial no.  
19          10/405,971, titled “Visual Representative Video Thumbnails Generation”, filed on  
20          04/01/2003, commonly assigned herewith, and hereby incorporated by reference.

21            **TECHNICAL FIELD**

22          [0007] The present disclosure generally relates to audio and video data. In  
23          particular, the disclosure relates to systems and methods of integrating audio, video  
24          and lyrical data in a karaoke application.

1      **BACKGROUND**

2      [0008] Karaoke is a form of entertainment originally developed in Japan, in  
3      which an amateur performer(s) sings a song to the accompaniment of pre-recorded  
4      music. Karaoke involves using a machine which enables performers to sing while  
5      being prompted by the words (lyrics) of the song which are displayed on a video  
6      screen that is synchronized to the music. In most applications, letters of the words  
7      of the song will turn color or be highlighted at the precise time during which they  
8      should be sung. In this manner, amateur singers are spared the burden of  
9      memorizing the lyrics to the song. As a result, the performance of the amateur  
10     singers is substantially enhanced, and the experience is greatly enhanced for the  
11     audience.

12     [0009] In some applications, a photograph may be shown by the video in the  
13     background, i.e. behind the lyrics of the song. The photograph provides added  
14     interest to the audience. However, the content of the video on the screen is  
15     provided, such as by video tapes, disks or other media, in a pre-recorded format.  
16     Accordingly, the video content is fixed, and the performer (and audience) is  
17     essentially stuck with the images that are pre-recorded in conjunction with the  
18     lyrics of the song.

19     [0010] The following systems and methods address the limitations of known  
20     karaoke systems.

1      **SUMMARY**

2      Systems and methods are described that implement personalized karaoke,  
3      wherein a user's personal home video and photographs are used to form a  
4      background for the lyrics during a karaoke performance. An exemplary karaoke  
5      apparatus is configured to segment visual content to produce a plurality of sub-  
6      shots and to segment music to produce a plurality of music sub-clips. Having  
7      produced the visual content sub-shots and music sub-clips, the exemplary karaoke  
8      apparatus shortens some of the plurality of sub-shots to a length of a corresponding  
9      music sub-clip from within the plurality of music sub-clips. The plurality of sub-  
10     shots is then displayed as a background to lyrics associated with the music, thereby  
11     adding interest to a karaoke performance.

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1      **BRIEF DESCRIPTION OF THE DRAWINGS**

2      [0011] The same reference numerals are used throughout the drawings to  
3      reference like components and features.

4      [0012] Fig. 1 is a block diagram showing elements of exemplary  
5      components and their relationship.

6      [0013] Fig. 2 is a table showing an exemplary frame difference curve  
7      (FDC).

8      [0014] Fig. 3 illustrates an exemplary lyric service and its relationship to a  
9      karaoke apparatus.

10     [0015] Fig. 4 illustrates exemplary operation of a karaoke apparatus.

11     [0016] Fig. 5 illustrates exemplary handling of shots and sub-shots obtained  
12    from video.

13     [0017] Fig. 6 illustrates exemplary operation wherein attention analysis is  
14    applied to a video sub-shot selection process.

15     [0018] Fig. 7 illustrates exemplary processing of shots obtained from  
16    photographs.

17     [0019] Fig. 8 illustrates exemplary processing of music sub-clips.

18     [0020] Fig. 9 illustrates exemplary processing of lyrics and related  
19    information.

20     [0021] Fig. 10 is a block diagram of an exemplary computing environment  
21    within which systems and methods to for personalized karaoke may be  
22    implemented.

**DETAILED DESCRIPTION**

**[0022] Exemplary Personalized Karaoke Structure**

[0023] In an exemplary personalized karaoke apparatus, visual content, such as personal home videos and photographs, are automatically selected from users' video and photo databases. The visual content, including video and photographs, are used in the background—behind the lyrics—in a karaoke system. Because the visual content is unique to the user, the user's family and the user's friends, the visual content personalizes the karaoke, adding interest and value to the experience.

[0024] Selection of particular video shots and photographs is made according to their content, the users' preferences and the type of music with which the visual content will be used. The available video content is filtered to allow selection of items of highest quality, interest level and applicability to the music. Lyrics are typically obtained from a lyrics service, and are generally delivered over the internet. In some implementations, a database of available lyrics may be accessed using a query-by-humming technology. Such technology operates by allowing the user to hum a few bars of the song, whereupon an interface to the database returns one or more possible matches to the song hummed. In other implementations, the database of available lyrics is accessed by keyboard, mouse or other graphical user interface.

[0025] The selected video clips, photographs and lyrics are displayed during performance of the karaoke song, with transitions between visual content coordinated according to the rhythm, melody or beat of the music. To enhance the experience, selected photographs are converted into motion photo clips by a Photo2Video technology, wherein camera angles change, zoom and pan the photo.

[0026] Fig. 1 is a block diagram showing elements of exemplary components of a personalized karaoke apparatus 100 and their relationship. A multimedia data acquisition module 102 is configured to obtain visual content including videos and photographs, as well as music and lyrics. In the exemplary implementation shown, my videos 104 and my photos 106 are typically folders defined on a local computer disk, such as on the user's personal computer. My videos 104 and my photos 106 may contain a number of videos such as home movies, and photographs such as from family photographic albums. In a preferred implementation, the visual content is in a digital format, such as that which results from a digital camcorder or a digital camera. Accordingly, to access visual content, the multimedia data acquisition module 102 typically accesses the folders 104, 106 on the user's computer's disk drive.

[0027] My music 108 and my lyrics 110 may be similar folders defined on the user's computer's hard drive. However, because songs and lyrics are copyrighted, and because they are not widely available, the user may wish to obtain both from a service. Accordingly, my music 108 and my lyrics 110 may be remotely located on a database which can provide karaoke songs (typically songs without lead vocalists) and karaoke lyrics. Such a database may be run by a karaoke service, which may use the Internet to sell or rent karaoke songs and karaoke lyrics to users. Accordingly, to access my music 108 and my lyrics 110, the multimedia data acquisition module 102 typically may access the folders 108, 110 on the user's computer's disk drive. Alternatively, as seen in Fig. 3, the multimedia data acquisition module 102 (Fig. 1) may communicate over the Internet 302 with a music service 300 to obtain karaoke songs and karaoke lyrics for use on the karaoke apparatus 100.

1 [0028] The format within which the lyrics are contained within my lyrics  
2 110 is not rigid; several formats may be envisioned. An exemplary format is seen  
3 in Table 1, wherein the lyrics may be configured in an XML document.

4 TABLE 1:

```
5 <Lyric>
6   <Group type = "solo" name = "singer1">
7     <Sentence start = " " stop = " ")>
8       <syllable start = " " stop = " " value = " " />
9       <syllable start = " " stop = " " value = " " />
10      <syllable start = " " stop = " " value = " " />
11      .....
12    </Sentence>
13    <Sentence start = " " stop = " ")>
14      .....
15    </Sentence>
16    .....
17    </Group>
18    <Group type = "solo" name = "singer2">
19      .....
20    </Group>
21    <Group type = "chorus" name = "singer1, singer 2">
```

22 [0029] As seen in the exemplary code of Table 1, the lyrics for a karaoke  
23 song may be contained within an XML document contained within my lyrics 110.  
24 The XML document provides that each syllable of each word of the song be  
25 located between quotes after the term "value", and that the start and stop times for  
that syllable are indicated between quotes after "start" and "stop". Similarly, the  
start and stop times for each sentence are indicated. In this application, the  
sentence may indicate one line of text. Thus, the exemplary XML document  
provides the entire lyrics to a given song, as well as the precise time period

1 wherein each syllable of each word in the lyrics should be displayed and  
2 highlighted during the karaoke song. Note that meta data is not shown in Table 1,  
3 but could be included to show artist, title, year of initial recording, etc.

4 [0030] A video analyzer 112 is typically configured in software. The video  
5 analyzer 112 is configured to analyze home videos, and may be implemented using  
6 a structure that is arranged in three components or software procedures: a parsing  
7 procedure to segment video temporally; an importance detection procedure to  
8 determine and to weight the video (or more generally, visual content) shots and  
9 sub-shots according to a degree to which they are expected to hold viewer  
10 attention; and a quality detection procedure to filter out poor quality video. Based  
11 on the results obtained by these three components, the video analyzer 112 selects  
12 appropriate or “important” video segments or clips to compose a background video  
13 for display behind the lyrics during the karaoke performance. The technologies  
14 upon which the video analyzer 112 is based are substantially disclosed in the  
15 references cited and incorporated by reference, above.

16 [0031] The video analyzer 112 obtains video—typically amateur home  
17 video obtained from my videos 104—and breaks the video into shots. Once  
18 formed, the shots may be grouped to form scenes, and may be subdivided to form  
19 sub-shots. The parsing may be performed using the algorithms proposed in the  
20 references cited and incorporated by reference, above, or by other known  
21 algorithms. For raw home videos, most of the shot boundaries are simple cuts,  
22 which are much more easily detected than are the shot boundaries associated with  
23 professionally edited videos. Accordingly, the task of segmenting video into shots is  
24 typically easily performed. Once a transition between two adjacent shots is  
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1 detected, the video temporal structure is further analyzed, such as by using by the  
2 following approach.

3 [0032] First, the shot is divided into smaller segments, namely, sub-shots,  
4 whose lengths (i.e. elapsed time during sub-shot play-back) are in a certain range  
5 required by the composer 122, as will be seen below. This is accomplished by  
6 detecting the maximum of the frame difference curve (FDC), as shown in Figure 2.

7 [0033] Fig. 2 shows elapsed time horizontally, and the magnitude of the  
8 difference between adjacent frames vertically. Thus, local maxima on the FDC  
9 tend to indicate camera movement which can indicate the boundary between  
10 adjacent shots or sub-shots. Continuing to refer to Fig. 2, it can be seen that three  
11 boundaries (labeled 1, 2 and 3) are located at the area wherein the difference  
12 between two adjacent frames is the highest.

13 [0034] By monitoring the difference between frames, the video analyzer 112  
14 is able to determine logical locations at which a video shot may be segmented to  
15 form two sub-shots. In a typical implementation, a shot is cut into two sub-shots at  
16 the maximum peak (such as 1, 2 or 3 in Fig. 2), if the peak is separated from the  
17 shot boundaries by at least the minimum length of a sub-shot. This process by  
18 which shots are segmented into sub-shots may be repeated until the lengths of all  
19 sub-shots are smaller than the maximum sub-shot length. As will be seen below,  
20 the maximum sub-shot length should be somewhat longer in duration than the  
21 length of music sub-clips, so that the video sub-shots may be truncated to equal the  
22 length of the music sub-clips.

23 [0035] And second, the video analyzer 112 may be configured to merge  
24 shots into groups of shots, i.e., scenes. There are many scene grouping methods  
25 presented in the literature. In an exemplary implementation, a hierarchical method

1 that merges the most “similar” adjacent scenes/shots step-by-step into bigger ones  
2 is employed. Adjacent scenes/shots may be considered to be similar, as indicated  
3 by a “similarity measure.” The similarity measure can be taken to be the  
4 intersection of an averaged and quantized color histogram in HSV color space,  
5 wherein HSV is a kind of color space model which defines a color space in terms  
6 of three constituent components: hue (color type, such as blue, red, or yellow),  
7 saturation (the “intensity” of the color), and value (the brightness of the color).  
8 The stop condition, by which the merging of adjacent scenes/shots is halted, can be  
9 triggered by either the similarity threshold or the final scene numbers. The video  
10 analyzer 112 may also be configured to build higher level structure on scene, i.e.,  
11 time, which is based on the time-code or timestamp of the shots. In this level,  
12 shots/scenes that shoot in the same time period are merged into one group.

13 [0036] The video analyzer 112 attempts to select “important” video shots  
14 from among the shots available. Generally, selecting appropriate or “important”  
15 video segments requires conceptual understanding of the video content, which may  
16 be abstract, known only to those who took the video, or otherwise difficult to  
17 discern. Accordingly, it is difficult to determine which shots are important within  
18 unstructured home videos. However, where the objective is creating a compelling  
19 background video for karaoke, it may not be necessary to completely understand  
20 the conceptual importance in the content of each video shot. As a more easily  
21 achieved alternative, the video analyzer 112 needs only determine those parts of  
22 the video more “important” or “attractive” than the others. Assuming that the most  
23 “important” video segments are those most likely to hold a viewer’s interest, the  
24 task becomes how to find and model the elements that are most likely to attract a  
25 viewer’s attention. Accordingly, the video analyzer 112 is configured to make

1 video segment selection based on the idea of determining which shots are the more  
2 important or more attractive than others, without fully understanding the factors  
3 upon which the differences in importance are based.

4 [0037] In one implementation, the video analyzer 112 is configured to detect  
5 object motion, camera motion and specific objects, which principally include  
6 people's faces. Importance to a viewer, and the resultant attention the viewer pays,  
7 are neurobiological concepts. In computing the attention a viewer pays to various  
8 scenes, the video analyzer 112 is configured to break down the problem of  
9 understanding a live video sequence into a series of computationally less  
10 demanding tasks. In particular, the video analyzer 112 analyzes video sub-shots  
11 and estimates their importance to perspective viewers based on a model which  
12 supposes that a viewer's attention is attracted by factors including: object motion;  
13 camera motion; specific objects (such as faces) and audio (such as speech, audio  
14 energy, etc.).

15 [0038] As a result, one implementation of the video analyzer 112 may be  
16 configured to produce an attention curve by calculating the attention/importance  
17 index of each video frame. Importance index for each sub-shot is obtained by  
18 averaging the attention indices of all video frames within this sub-shot.  
19 Accordingly, sub-shots may be compared based on their importance and predicted  
20 ability to hold an audience's attention. As a byproduct, motion intensity, and  
21 camera motion (type and speed) for each sub-shot, is also obtained.

22 [0039] The video analyzer 112 is also configured to detect the video quality  
23 level of shots, and therefore to compare shots on this basis, and to eliminate shots  
24 having poor video quality from selection. Since most home videos are recorded by  
25 unprofessional home users operating camcorders, there are often low quality

1 segments in the recordings. Some of those low quality segments result from  
2 incorrect exposure, an unsteady camera, incorrect focus settings, or because the  
3 users forgot to turn off camera, resulting in time during which floors or walls are  
4 unintentionally recorded. Most of these low quality segments that are not caused  
5 by camera motion can be detected by examining their color entropy. However,  
6 sometimes, good quality video frames also have low entropies, such as in videos of  
7 skiing events. Therefore, an implementation of the video analyzer 112 combines  
8 both motion analyses with the entropy approach, thereby reducing false  
9 assumptions of poor video quality. That is, the video analyzer 112 considers  
10 segments to possibly be of low quality only when both entropy and motion  
11 intensity are low. Alternatively, the video analyzer 112 may be configured with  
12 other approaches for detecting incorrectly exposed segments, as well as low quality  
13 segments caused by camera shaking.

14 [0040] For example, very fast panning segments caused by rapidly changing  
15 viewpoints, and fast zooming segments are detected by checking camera motion  
16 speed. The video analyzer 112, as configured above, filters from the selection  
17 these segments, since they are not only blurred, but also lack appeal.

18 [0041] A photo analyzer 114 is typically configured in software. The photo  
19 analyzer 114 may be substituted for, or work in conjunction with, the video  
20 analyzer 112. Accordingly, the background for the karaoke lyrics can include  
21 video from my videos 104 (or other source), photos from my photos 106, or both.  
22 The photo analyzer 114 is configured to analyze photographs, and may be  
23 implemented using a structure that is arranged in three components or software  
24 procedures: a quality filter to identify poor-quality photos; a grouping function to  
25

1 attractively group compatible photographs; and a focal area detector, to detect a  
2 focal-area or interest-area that is likely grab the attention of the karaoke audience.

3 [0042] In one implementation, the photo analyzer 114 uses photo grouping  
4 only when using photographs. However, where the video analyzer 112 and photo  
5 analyzer 114 are both used, each photograph may be regarded as a video shot  
6 (which contain only one sub-shot, i.e., the shot itself), and then use video scene  
7 grouping to form groups. In an even more general sense, video and photographs,  
8 both having shots and sub-shots, may be considered to be visual content, also  
9 having shots and sub-shots. In that case, photo importance is the entropy of the  
10 quantized HSV color histogram.

11 [0043] Since most of the photographs within my photos 106 were taken by  
12 unprofessional home users, they frequently include many low quality photographs,  
13 having one or more of the following faults: Under or over exposed images, e.g.,  
14 the photographs that are taken when the exposure parameters were not correctly set.  
15 This problem can be detected by checking whether the average brightness of the  
16 photograph is too low or too high. Homogenous images, e.g., floor, wall. This  
17 problem can be detected by checking whether the color entropy is too low. These  
18 photographs always have no salient object in which user may have interest.  
19 Blurred photographs. This problem can be detected by know methods.

20 [0044] While some of the problems above could be alleviated, repaired or  
21 adjusted, the photo analyzer 114 is typically configured to discard the photo from  
22 consideration. Accordingly, further discussion assumes that the photo analyzer  
23 114 has eliminated photos having the above faults from consideration, i.e. such  
24 flawed photos are removed from consideration by the photo analyzer 114.

1 [0045] One implementation of the photo analyzer 114 uses a three-criterion  
2 procedure to group photographs into three tiers. That is, photographs are grouped  
3 by: the date the photo was taken; the scene within the photo; and if the photo is a  
4 member of a group of very similar photographs. The first criterion, i.e., the date,  
5 allows discovery of all photographs taken on a certain date. The date may be  
6 obtained from the metadata of digital photographs, or from OCR results from  
7 analog photographs that have date stamps. If none of these two kinds of  
8 information can be obtained, the date on which the file was created is used. The  
9 second criterion, the scene, represents a group of photographs that, while not as  
10 similar as those which fall under the third criterion, were taken at the same time  
11 and place.

12 [0046] The photo analyzer 114 uses photos falling within the scope of the  
13 first two criteria. Accordingly, date and scene will be used to determine transition  
14 types and support editing styles, as to be explained later. Photos falling under the  
15 third criteria, that is falling within a group of very similar photos, are filtered out  
16 (except, possibly, for one such photograph). Groups of very similar photographs  
17 are result when photographers often take several photographs for the same or  
18 nearly the same object or scene. By eliminating such groups of photos, the photo  
19 analyzer 114 prevents boring periods of time during the karaoke performance.

20 [0047] In one embodiment of the photo analyzer 114, photographs are firstly  
21 grouped into a top-tier labeled ‘day’ based on the date information. Then, a  
22 hierarchical clustering algorithm with different similarity thresholds is used to  
23 group the lower two layers. In particular, photographs with a lower degree of  
24 similarity are grouped together as a “scene.” Another group of photographs is  
25 formed having a higher degree of similarity.

1           **[0048]** The photo analyzer 114 may be configured to time-constrain the  
2 lower two layers. For time constrained grouping, each group contains photographs  
3 in a certain period of time. There is no time overlap between different groups.  
4 The photo analyzer 114 may use time and order of photograph creation to assist in  
5 clustering photos, i.e. photograph groups may consist of temporally contiguous  
6 photographs. Where the photo analyzer 114 includes a content-based clustering  
7 algorithm using best-first probabilistic model merging, it performs rapidly and  
8 yields clusters that are often related by content.

9           **[0049]** If no time constraint is needed, the photo analyzer 114 may be  
10 configured to group photographs according to their content similarity only.  
11 Accordingly, the photo analyzer 114 may use a simple hierarchical clustering  
12 method for grouping, and an intersection of HSV color histogram may be used as a  
13 similarity measure of two photographs or two clusters of photographs.

14           **[0050]** The photo analyzer 114 may be configured for “focus element  
15 detection,” i.e. the detection of an element within the photograph upon which  
16 viewers will focus their attention. Focus element detection is the preparation step  
17 for photo to video, which will be described with more detail, below. The focus  
18 detection technologies used within the photo analyzer 114 can include those  
19 disclosed in documents incorporated by reference, above.

20           **[0051]** The photo analyzer 114 recognizes focal elements in the photographs  
21 that most likely attract viewers’ attention. Typically human faces are more  
22 attractive than other objects, so the photo analyzer 114 employs a face or attention  
23 area detector to detect areas, e.g. an “attention area,” to which people may directed  
24 their attention, such as toward dominant faces in the photographs. A limit, such as  
25 100 pixels square, on the smallest face recognized, typically results in more

1 attractive photo selection. As will be seen in greater detail below, the focal  
2 element(s) are the target area(s) within the photographs wherein a simulated  
3 camera will pan and/or zoom.

4 [0052] The photo analyzer 114 may also employ a saliency-based visual  
5 attention model for static scene analysis. Based on the saliency map obtained by  
6 this method, separate attention areas/spots are then obtained, where the saliency  
7 map indicates that the area/spots exceed a threshold. Attention areas that have  
8 overlap with faces are removed.

9 [0053] A music analyzer 116 is typically configured in software. The music  
10 analyzer 116 may be configured with technology from the documents incorporated  
11 by reference, above. In order to align video shots (including photographs) with  
12 boundaries defined by musical beat—i.e., make the video transition happened at  
13 the beat positions of the incidental music—the music analyzer 116 segments the  
14 music into several music sub-clips, whose boundary is at the beat position. Each  
15 video sub-shot (in fact, it is a shot in the generated background video) is shown  
16 during the playing of one music sub-clip. This not only ensures that the video shot  
17 transition occurs at the beat position, but also sets the duration of the video shot.

18 [0054] In an alternative implementation of the music analyzer 116, an onset  
19 (e.g. initiation of a distinguishable tone) may be used in place of the beat. Such  
20 use may be advantageous when beat information is not obvious during portions of  
21 the song. The strongest (e.g. loudest) onset in a window of time may be assumed  
22 to be a beat. This assumption is reasonable because there will typically be several  
23 beat positions within a window, which extends, for example, for three seconds.  
24 Accordingly, a likely location to find a beat is the position of the strongest onset.

1           **[0055]** The music analyzer 116 controls the length of the music sub-clips to  
2 prevent excessive length and corresponding audience boredom during the karaoke  
3 performance. Recall that the time-duration of the music sub-clip drives the time-  
4 duration during which the video sub-shots (or photos) are displayed. In general,  
5 changing the music sub-clip on the beat and with reasonable frequency results in  
6 the best performance. To give a more enjoyable karaoke performance, the sub-  
7 music should not be too short or too long. In one embodiment of the music  
8 analyzer 116, an advantageous length of sub-music clip is about 3 to 5 seconds.  
9 Once a first music sub-clip is set, additional music sub-clips can be segmented by  
10 the following way: given the previous boundary, the next boundary is selected as  
11 the strongest onset in the window which is 3-5 seconds (an advantageous music  
12 sub-clip length) from the previous boundary.

13           **[0056]** Other implementations of the music analyzer 114 could be  
14 configured to set the music sub-clip length manually. Alternatively, the music  
15 analyzer 114 could be configured to set the music sub-clip length automatically,  
16 according to the tempo of the musical content. In this implementation, when the  
17 music tempo is fast, the length of music sub-clip is short; otherwise, the length of  
18 music sub-clip is long.

19           **[0057]** As will be seen below, after the lengths of each music sub-clip  
20 within the song are determined by the music analyzer 114, video sub-shot  
21 transition can be easily placed at the music beat position just by aligning the  
22 duration of a video shot and the corresponding music sub-clip.

23           **[0058]** A lyric formatter 118 is configured to generate syllable-by-syllable  
24 rendering of the lyrics required for karaoke. In performing such a rendering, the  
25 lyric formatter 118 positions each syllable of the lyrics on the screen in alignment

1 with the music of the selected song. To perform the rendering, each syllable is  
2 associated with a start time and a stop time, between which the syllable is  
3 emphasized, such as by highlighting, so that the singer can see what to sing. As  
4 seen in Table 1, the required information may be provided in an XML document.

5 [0059] The lyric formatter 118 may be configured to obtain an XML file  
6 such as that seen in Table 1, from a lyric service, which may operate on a pay-for-  
7 play service over the Internet. In this case, the lyric formatter 118 may obtain the  
8 lyrics through a network interface 126. The lyric service can be a charged service  
9 over the Internet, or can be located on the user's hard disk at 110.

10 [0060] A content selector 120 is configured to select visual content, i.e.  
11 videos or photographs, for segmentation and display as background to the karaoke  
12 lyrics. As aforementioned, the background video could be video segments from  
13 my videos 104 only, photographs from my photos 106 only, or a combination of  
14 video segments and photographs. Where the visual content selected includes both  
15 videos and photographs, each photograph can be regarded to be a shot (and also a  
16 sub-shot), and photograph groups can be regarded as "scenes." The content  
17 selector may be configured to select video content using video content selection  
18 technologies used in "Systems and Methods for Automatically Editing a Video,"  
19 which was previously incorporated by reference.

20 [0061] To ensure that the selected video clips and/or photograph are of  
21 satisfactory quality, the content selector 120 incorporates two rules derived from  
22 studying professional video editing. By complying with the two rules, the content  
23 selector 120 is able to select suitable segments that are representative of the  
24 original video in content and of high visual quality. First, using a long unedited  
25 video as a karaoke background is boring, principally because of the redundant, low

1 quality segments common in most home videos. Accordingly, an effective way to  
2 compose compelling video content for karaoke is to preserve the most critical  
3 features within a video—such as those that tell a story, express a feeling or  
4 chronicle an event—while removing boring and redundant material. In other  
5 words, the editing process should select segments with greater relative  
6 “importance” or “excitement” value from the raw video.

7 [0062] A second guideline indicates that, for a given video, the most  
8 “important” segments according to an importance measure could concentrate in  
9 one or in a few parts of the time line of the original video. However, selection of  
10 only these highlights may actually obscure the storyline found in the original  
11 video. Accordingly, the distribution of the selected highlight video should be as  
12 uniform along the time line as possible so as to preserve the original storyline.

13 [0063] The content selector 120 is configured to utilize these rules in  
14 selecting video sub-shots; i.e. to select the “important” sub-shots in a manner  
15 which results in selection of sub-shots distributed throughout the video. The  
16 configurations within the content selector 120 can be formulated as if to address an  
17 optimization problem, wherein two computable objectives include: selecting  
18 “important” sub-shots; and selected sub-shots in as nearly uniformly distributed a  
19 manner as possible. The first objective is achieved by examining the average  
20 attention index of each sub-shot. The second objective, distribution uniformity, is  
21 addressed by study of the normalized entropy of the selected shots distributed  
22 along the timeline of the raw home videos.

23 [0064] A karaoke composer 122 is typically configured in software. The  
24 karaoke composer 122 provides solutions for shot boundaries, music beats and  
25 lyric alignment. Additionally, the composer 122 is configured to convert a

1 photograph or a series of photographs into videos. And still further, the composer  
2 122 is configured for connecting video sub-shots with specific transitions within  
3 music sub-clips. In some implementations, the composer 122 is configured for  
4 applying transformation effects on shots and for supporting styles which support a  
5 “theme” to the karaoke presentation.

6 [0065] The karaoke composer 122 is configured to align sub-shot transitions  
7 with music beats (which typically define the edges of music sub-clips). To make  
8 the karaoke background video more expressive and attractive, the karaoke  
9 composer 122 puts shot transitions at music beats, i.e., at the boundaries between  
10 the music sub-clips. This alignment requirement is met by the following alignment  
11 strategy. The minimum duration of sub-shots is made greater than maximum  
12 duration of music sub-clips. For example, the karaoke composer 122 may set  
13 music sub-clip duration in the range between 3 and 5 seconds, while sub-shots  
14 duration in 5 to 7 seconds. Since sub-shot durations are generally greater than  
15 music sub-clips, the karaoke composer 122 can shorten the sub-shots to match  
16 their duration to that of the corresponding music sub-clips. Another alignment  
17 issue is character-by-character or syllable-by syllable lyric rendering. Because the  
18 time for display and highlight of each syllable has been clearly indicated in the  
19 lyric file, the karaoke composer 122 is able to accomplish this objective.

20 [0066] In one implementation, the karaoke composer 122 is configured to  
21 support photo-to-video technology. Photo-to-video is a technology developed to  
22 automatically convert photographs into video by simulating temporal variation of  
23 people's study of photographic images using camera motions. When we view a  
24 photograph, we often look at it with more attention to specific objects or areas of  
25 interest after our initial glance at the overall image. In other words, viewing

1 photographs is a temporal process which brings enjoyment from inciting memory  
2 or from rediscovery. This is well evidenced by noticing how many documentary  
3 movies and video programs often present a motion story based purely on still  
4 photographs by applying well-designed camera operations. That is, a single  
5 photograph may be converted into a motion photograph clip by simulating  
6 temporal variation of viewer's attention using camera motions. For example,  
7 zooming simulates the viewer looking into the details of a certain area of an image,  
8 while panning simulates scanning through several important areas of the  
9 photograph. Furthermore, a slide show created from a series of photographs is  
10 often used to tell a story or chronicle an event. Connecting the motion photograph  
11 clips following certain editing rules forms a slide show in this style, a video which  
12 is much more compelling than the original images.

13 [0067] The karaoke composer 122 may be configured to utilize the focal  
14 points discovered by the photo analyzer 114. As seen above, focal points are areas  
15 in a photograph that most likely will attract a viewer's attention or focus. These  
16 areas are used to determine the camera motions to be applied to the image, based  
17 on a similar technology as Microsoft Photo Story™.

18 [0068] In one implementation, the karaoke composer 122 is configured to  
19 produce a number of transitions and effects. For example, transformation effects  
20 provided by Microsoft Movie Maker 2 can be used to implement the karaoke  
21 composer 122, including grayscale, blurring, fading in/out, rotation, thresholds,  
22 sepia tone, etc. A number of effects provided by Microsoft DirectX and Movie  
23 Maker may also be included with the karaoke composer 122, including cross fade,  
24 checkerboard, circle, wipe, slide, etc. The transformation and transition effects  
25 can be selected randomly in a specific effect set, or determined by the styles.

1 Simple rules for transition selection are also employed. For example, we use  
2 “cross fade” for the sub-shots/photographs in the same scene/group/day, use others  
3 randomly selected transitions as a new day/group/day comes out.

4 [0069] The karaoke composer 122 may include extensions, including  
5 different styles according to users’ preference. As many styles may be defined as  
6 desired. Three exemplary styles are show below, namely, music video, day-by-  
7 day, and old movie, to show how the karaoke composer 122 may support different  
8 styles.

9 [0070] The karaoke composer 122 may be configured to produce a “music  
10 video” style. In this style, the karaoke composer 122 segments the music  
11 according to the tempo of the music. Accordingly, if the music is fast, the music  
12 sub-clip will be shorter, and vice versa. Then video segments and/or photographs  
13 are fused to the music to get the background video by the following rules for  
14 transformation effects and transition effects. Transformation effects may be  
15 achieved by applying effects—randomly selected from the entire effect set—on a  
16 randomly selected half of the sub-shots. Transition effects may be achieved by  
17 applying transitions—randomly selected from the entire transition set, except  
18 “cross fade”—to a randomly selected half of the sub-shots changes. For other sub-  
19 shots changes, we use “cross fade”.

20 [0071] The karaoke composer 122 may be configured to produce a “day-by-  
21 day” style. In this style, the karaoke composer 122 adds a title when the new day  
22 starts before the first sub-shot of the day to illustrate the creating date of the sub-  
23 shots coming next. Exemplary rules for transformation effects and transitions are  
24 defined below. Transformation effects may include a “fade in” effect which is  
25 added on the first sub-shots of each day, while a “fade out” effect is added on the

1 last sub-shots of each day. Transition effects may include a “fade” between sub-  
2 shots that are in the same day, and use randomly selected effects when a new day  
3 begins.

4 [0072] The karaoke composer 122 may be configured to produce an “old  
5 movie” style. In this style, the karaoke composer 122 adds sepia tone or grayscale  
6 effect on all sub-shots, while only “fade right” transitions are used between sub-  
7 shots.

8 [0073] The karaoke composer 122 may be configured to resolve differences  
9 in the number of the sub-shots and the number of music sub-clips. In general, the  
10 karaoke composer 120 will dispose of extra sub-shots, in any of several ways. If  
11 the number of sub-shots/photographs (after quality filtering and selecting) is less  
12 than the number of sub-music clips, repeat the sub-shots.

13 [0074] A user interface 124 on the karaoke apparatus 100 allows the user to  
14 select a song for use in the karaoke performance. In one embodiment of the  
15 karaoke apparatus 100, the user interface allows the user to hum a few bars of the  
16 song. The interface 126 then communicates with the database my music 108, from  
17 which one or more possible matches to the humming are presented. The user may  
18 select from one of them, repeat the process, or type in a song having a known title.

19 [0075] Exemplary Methods

20 [0076] Exemplary methods for implementing aspects of personalized  
21 karaoke will now be described with primary reference to the flow diagrams of  
22 Figs. 4—9. The methods apply generally to the operation of exemplary  
23 components discussed above with respect to Figs. 1—3. The elements of the  
24 described methods may be performed by any appropriate means including, for  
25

1 example, hardware logic blocks on an ASIC or by the execution of processor-  
2 readable instructions defined on a processor-readable medium.

3 [0077] A "processor-readable medium," as used herein, can be any means  
4 that can contain, store, communicate, propagate, or transport instructions for use  
5 by or execution by a processor. A processor-readable medium can be, without  
6 limitation, an electronic, magnetic, optical, electromagnetic, infrared, or  
7 semiconductor system, apparatus, device, or propagation medium. More specific  
8 examples of a processor-readable medium include, among others, an electrical  
9 connection having one or more wires, a portable computer diskette, a random  
10 access memory (RAM), a read-only memory (ROM), an erasable programmable-  
11 read-only memory (EPROM or Flash memory), an optical fiber, a rewritable  
12 compact disc (CD-RW), and a portable compact disc read-only memory  
13 (CDROM).

14 [0078] Fig. 4 shows an exemplary method 400 for implementing  
15 personalized karaoke. At block 402, visual content is obtained from local memory.  
16 In most cases, the visual content involves the personal home movies (usually  
17 digital video) and personal photo album (usually digital images) of the user. As  
18 seen in the exemplary implementation above, the multimedia data acquisition  
19 module 102 obtains visual content from my videos 104 and my photos 106.

20 [0079] At block 404, the visual content is segmented to produce a plurality  
21 of sub-shots. As seen above, the video analyzer 112 includes a parsing procedure  
22 to segment video. Similarly, at block 406, music is segmented to produce a  
23 plurality of music sub-clips. As seen in the exemplary implementation above, the  
24 music analyzer 116 is configured to segment music into sub-clips, typically at beat  
25 locations. At block 408, the video sub-shots are shortened, as needed, to a length

1 appropriate to the length of corresponding music sub-clips. At block 410, during  
2 the karaoke performance, selected video sub-shots are displayed as background to  
3 lyrics associated with the music.

4 [0080] Fig. 5 shows another exemplary method 500 for handling of shots  
5 sub-shots obtained from video. At block 502, a video shot is divided into two sub-  
6 shots at a maximum peak of a frame difference curve. As seen in Fig. 2, the frame  
7 difference curve 200 indicates locations 1, 2 and 3 wherein the difference between  
8 adjacent frames is high. Accordingly, at block 502 the video shot may be divided  
9 into sub-shots at such a location.

10 [0081] At block 504, the division of sub-shots may be repeated to result in  
11 sub-shots shorter than a maximum value. Excessively long video sub-shots tend to  
12 result in boring karaoke performances.

13 [0082] At block 506, the plurality of sub-shots is filtered as a function of  
14 quality. As seen above, a quality detection procedure within the video analyzer  
15 112 is configured to filter out poor quality video.

16 [0083] Several options may be performed, singly or in mass. In a first  
17 option seen at block 510, the color entropy of the sub-shots may be examined. As  
18 seen above, the video analyzer 112 examines color entropy as one factor in  
19 determining the quality of each sub-shot.

20 [0084] In a second option seen at block 508, each of the plurality of sub-  
21 shots is analyzed to detect motion. Motion, both of the camera and objects within  
22 the video, within limits, is generally indicative of higher quality video.  
23 Sometimes, good quality video frames also have low entropies, such as in videos  
24 of skiing events. Therefore, an implementation of the video analyzer 112  
25 combines both motion analyses with the entropy approach, thereby reducing false

1 assumptions of poor video quality. That is, the video analyzer 112 considers  
2 segments to possibly be of low quality only when both entropy and motion  
3 intensity are low.

4 [0085] At block 512, it is generally the case that sub-shots having  
5 acceptable motion and/or acceptable color entropy should be selected. Where both  
6 of these factors appear lacking, it is generally indicative of a poor quality sub-shot.

7 [0086] At block 514, an appropriate set of sub-shots is selected from the  
8 video. The selection is typically performed by the content selector 120, which may  
9 be configured to make the selection in a manner consistent with two objectives.  
10 In a first objective, seen at block 516, important shots are selected from among the  
11 plurality of sub-shots. As an example seen above, the video analyzer 112 selects  
12 appropriate or “important” video segments or clips to compose a background video  
13 for display behind the lyrics during the karaoke performance. In a second  
14 objective, seen at block 518, the video analyzer selects sub-shots that are uniformly  
15 distributed within the video. By obtaining uniform distribution, all parts of the  
16 story told by the video are represented. One method that may be utilized to  
17 accomplish this objective includes the evaluation of the normalized entropy of the  
18 sub-shots within the video.

19 [0087] Fig. 6 shows an exemplary method 600 wherein attention analysis is  
20 applied to a video sub-shot selection process. At block 602, frames are evaluated  
21 within a sub-shot for attention indices. As seen above, one implementation of the  
22 video analyzer 112 was configured to produce an attention curve by calculating the  
23 attention/importance index of each video frame. At block 604, the importance  
24 index for each sub-shot is obtained by averaging the attention indices of all video  
25 frames within this sub-shot. Accordingly, sub-shots may be compared, and a

1 selection between sub-shots made, based on their importance and predicted ability  
2 to hold an audience's attention.

3 [0088] At block 606, camera motion and object motion is analyzed.  
4 Generally, where the camera is moving (within limits), or where objects within the  
5 field of view are moving (again, within limits) the audience will be paying  
6 attention to the video. Additionally, analysis is made in an attempt to recognize  
7 specific objects, such as people's faces. Where faces are detected, additional  
8 audience interest is likely.

9 [0089] At block 608, the video analyzer 112 or similar apparatus filters the  
10 sub-shots according to the analysis performed at blocks 602—606.

11 [0090] Fig. 7 shows another exemplary method 700 for processing of shots  
12 obtained from photographs. Blocks 702—708 may be performed by a photo  
13 analyzer 114, as seen above, or by similar software or apparatus. At block 702, the  
14 photo analyzer 114 rejects photographs having quality problems. As seen above,  
15 the quality problems can include under/over exposure, overly homogeneous  
16 images, blurred images, and others. At block 704, the photo analyzer 114 rejects  
17 (except, perhaps one) photographs within a group of very similar photographs. At  
18 block 706, the photo analyzer 114 selects photographs having an interest area. As  
19 seen above, a key interest area would be a human face; however, other interest  
20 points could be designated. At block 708, where a photograph having an interest  
21 area is selected, the photo analyzer 114 converts the photo to video. As seen  
22 above, the photo analyzer 114 typically uses panning and zooming to create a  
23 "video-like" experience from the still photograph.

24 [0091] Fig. 8 shows another exemplary method 800 for processing of music  
25 sub-clips. At block 802, a range is set for the length of the music sub-clips

1 generally (as opposed to the length of specific music sub-clips). In particular, at  
2 option 1 block 804, the range is set as a function of tempo. For example, the  
3 minimal length of the music sub-clips can be set at: minimum length =  
4  $\min\{\max\{2 * \text{tempo}, 2\}, 4\}$ , in seconds. The maximum length of the music may be  
5 set at: maximum length = minimum + 2, also in seconds.

6 [0092] At block 806, the music sub-clip length may be set to be within a  
7 fixed range, such as 3 to 5 seconds. Recall that the music sub-clip length is then  
8 matched by the length of the sub-shots. Accordingly, the sub-shot—video or  
9 photograph—will then change every 3 to 5 seconds. This rate of change may be  
10 fine-tuned as desired, in attempt to create the most interesting karaoke  
11 performance.

12 [0093] At block 808, specific lengths for specific music sub-clips are  
13 established. In blocks 802—806 the range of music sub-clips was determined.  
14 Here the karaoke composer 122 or other software procedure defines specific  
15 lengths for each music sub-clip. At block 810, the music sub-clip boundaries are  
16 established at beat positions, located according to the rhythm or tempo of the  
17 music. This produces changes in the video sub-shot at beat positions, which tends  
18 to generate interest and expectation among the karaoke audience. Alternatively,  
19 where the beat is erratic or overly subtle, the lengths of each music sub-clip can be  
20 set using the onset.

21 [0094] At block 812, the boundaries of the music sub-clips may be set at the  
22 boundaries of sentence breaks. This results in a new video sub-shot for every line  
23 of lyrics.

24 [0095] Fig. 9 shows another exemplary method 900 for processing of lyrics  
25 and related information. At block 902, the user may query a database by humming

1 a portion of a desired song. For example, a user interface 124 may be configured  
2 to allow the user to hum the song. The user interface 124 could communicate with  
3 the database my music 108. At block 904, the user selects a desired song from  
4 among possible matches for the song. At block 906, in response to the selection of  
5 the desired song, a request for an XML document associated with the song is  
6 made. The request may be made to my lyrics 110, which may be on-site or off-site.  
7 At block 908, the request for lyrics is fulfilled. For example, a CD-ROM may  
8 provide a number of karaoke songs (vocal-less music) and associated XML lyrics  
9 documents. Such a disk may be purchased and located within the user's karaoke  
10 apparatus 100 (Fig. 1). Alternatively, the XML documents and karaoke songs may  
11 be off-site, and may be accessed over the Internet through the network interface  
12 126. For example, Fig. 3 illustrates a karaoke apparatus 100 configured to  
13 communicate over a network 302 with a lyric service 300. At block 910, the XML  
14 document is sent over a network to the karaoke apparatus 100. In the example of  
15 Fig. 3, XML files—which may be configured as seen in Table 1—can be sent from  
16 the lyric service 300 to the karaoke apparatus 100.

17 [0096] At block 912 lyrics are obtained from an XML document. As was  
18 seen earlier in the discussion of Table 1, each syllable of the lyrics is present in the  
19 XML document, including a definition of the time slot within which the syllable  
20 should be displayed (within a sentence) and also highlighted during the  
21 performance. At block 914, the delivery of the lyrics is coordinated with the  
22 deliver of the music using timing information from the XML document.  
23 Accordingly, the lyrics are rendered, syllable by syllable, to the screen 224, with  
24 the correct timing.

1 [0097] While one or more methods have been disclosed by means of flow  
2 diagrams and text associated with the blocks of the flow diagrams, it is to be  
3 understood that the blocks do not necessarily have to be performed in the order in  
4 which they were presented, and that an alternative order may result in similar  
5 advantages. Furthermore, the methods are not exclusive and can be performed  
6 alone or in combination with one another.

7 [0098] Exemplary Computing Environment

8 [0099] Fig. 10 illustrates an example of a computing environment 1000  
9 within which the application data processing systems and methods, as well as the  
10 computer, network, and system architectures described herein, can be either fully  
11 or partially implemented. Exemplary computing environment 1000 is only one  
12 example of a computing system and is not intended to suggest any limitation as to  
13 the scope of use or functionality of the network architectures. Neither should the  
14 computing environment 1000 be interpreted as having any dependency or  
15 requirement relating to any one or combination of components illustrated in the  
16 exemplary computing environment 1000.

17 [0100] The computer and network architectures can be implemented with  
18 numerous other general purpose or special purpose computing system  
19 environments or configurations. Examples of well known computing systems,  
20 environments, and/or configurations that may be suitable for use include, but are  
21 not limited to, personal computers, server computers, thin clients, thick clients,  
22 hand-held or laptop devices, multiprocessor systems, microprocessor-based  
23 systems, set top boxes, programmable consumer electronics, network PCs,  
24 minicomputers, mainframe computers, gaming consoles, distributed computing  
25 environments that include any of the above systems or devices, and the like.

1 [0101] The computing environment 1000 includes a general-purpose  
2 computing system in the form of a computing device 1002. The components of  
3 computing device 1002 can include, by are not limited to, one or more processors  
4 1004 (e.g., any of microprocessors, controllers, and the like), a system memory  
5 1006, and a system bus 1008 that couples various system components including the  
6 processor 1004 to the system memory 1006. The one or more processors 1004  
7 process various computer-executable instructions to control the operation of  
8 computing device 1002 and to communicate with other electronic and computing  
9 devices.

10 [0102] The system bus 1008 represents any number of several types of bus  
11 structures, including a memory bus or memory controller, a peripheral bus, an  
12 accelerated graphics port, and a processor or local bus using any of a variety of bus  
13 architectures. By way of example, such architectures can include an Industry  
14 Standard Architecture (ISA) bus, a Micro Channel Architecture (MCA) bus, an  
15 Enhanced ISA (EISA) bus, a Video Electronics Standards Association (VESA)  
16 local bus, and a Peripheral Component Interconnects (PCI) bus also known as a  
17 Mezzanine bus.

18 [0103] Computing environment 1000 typically includes a variety of  
19 computer-readable media. Such media can be any available media that is  
20 accessible by computing device 1002 and includes both volatile and non-volatile  
21 media, removable and non-removable media. The system memory 1006 includes  
22 computer-readable media in the form of volatile memory, such as random access  
23 memory (RAM) 1010, and/or non-volatile memory, such as read only memory  
24 (ROM) 1012. A basic input/output system (BIOS) 1014, containing the basic  
25 routines that help to transfer information between elements within computing

1 device 1002, such as during start-up, is stored in ROM 1012. RAM 1010 typically  
2 contains data and/or program modules that are immediately accessible to and/or  
3 presently operated on by the processing unit 1004.

4 [0104] Computing device 1002 can also include other  
5 removable/non-removable, volatile/non-volatile computer storage media. By way  
6 of example, a hard disk drive 1016 is included for reading from and writing to a  
7 non-removable, non-volatile magnetic media (not shown), a magnetic disk drive  
8 1018 for reading from and writing to a removable, non-volatile magnetic disk 1020  
9 (e.g., a “floppy disk”), and an optical disk drive 1022 for reading from and/or  
10 writing to a removable, non-volatile optical disk 1024 such as a CD-ROM, DVD,  
11 or any other type of optical media. The hard disk drive 1016, magnetic disk drive  
12 1018, and optical disk drive 1022 are each connected to the system bus 1008 by  
13 one or more data media interfaces 1026. Alternatively, the hard disk drive 1016,  
14 magnetic disk drive 1018, and optical disk drive 1022 can be connected to the  
15 system bus 1008 by a SCSI interface (not shown).

16 [0105] The disk drives and their associated computer-readable media  
17 provide non-volatile storage of computer-readable instructions, data structures,  
18 program modules, and other data for computing device 1002. Although the  
19 example illustrates a hard disk 1016, a removable magnetic disk 1020, and a  
20 removable optical disk 1024, it is to be appreciated that other types of  
21 computer-readable media which can store data that is accessible by a computer,  
22 such as magnetic cassettes or other magnetic storage devices, flash memory cards,  
23 CD-ROM, digital versatile disks (DVD) or other optical storage, random access  
24 memories (RAM), read only memories (ROM), electrically erasable programmable  
25

1 read-only memory (EEPROM), and the like, can also be utilized to implement the  
2 exemplary computing system and environment.

3 [0106] Any number of program modules can be stored on the hard disk  
4 1016, magnetic disk 1020, optical disk 1024, ROM 1012, and/or RAM 1010,  
5 including by way of example, an operating system 1026, one or more application  
6 programs 1028, other program modules 1030, and program data 1032. Each of  
7 such operating system 1026, one or more application programs 1028, other  
8 program modules 1030, and program data 1032 (or some combination thereof)  
9 may include an embodiment of the systems and methods for a test instantiation  
10 system.

11 [0107] Computing device 1002 can include a variety of computer-readable  
12 media identified as communication media. Communication media typically  
13 embodies computer-readable instructions, data structures, program modules, or  
14 other data in a modulated data signal such as a carrier wave or other transport  
15 mechanism and includes any information delivery media. The term “modulated  
16 data signal” refers to a signal that has one or more of its characteristics set or  
17 changed in such a manner as to encode information in the signal. By way of  
18 example, and not limitation, communication media includes wired media such as a  
19 wired network or direct-wired connection, and wireless media such as acoustic,  
20 RF, infrared, and other wireless media. Combinations of any of the above are also  
21 included within the scope of computer-readable media.

22 [0108] A user can enter commands and information into computing device  
23 1002 via input devices such as a keyboard 1034 and a pointing device 1036 (e.g., a  
24 “mouse”). Other input devices 1038 (not shown specifically) may include a  
25 microphone, joystick, game pad, controller, satellite dish, serial port, scanner,

1 and/or the like. These and other input devices are connected to the processing unit  
2 1004 via input/output interfaces 1040 that are coupled to the system bus 1008, but  
3 may be connected by other interface and bus structures, such as a parallel port,  
4 game port, and/or a universal serial bus (USB).

5 [0109] A monitor 1042 or other type of display device can also be connected  
6 to the system bus 1008 via an interface, such as a video adapter 1044. In addition  
7 to the monitor 1042, other output peripheral devices can include components such  
8 as speakers (not shown) and a printer 1046 which can be connected to computing  
9 device 1002 via the input/output interfaces 1040.

10 [0110] Computing device 1002 can operate in a networked environment  
11 using logical connections to one or more remote computers, such as a remote  
12 computing device 1048. By way of example, the remote computing device 1048  
13 can be a personal computer, portable computer, a server, a router, a network  
14 computer, a peer device or other common network node, and the like. The remote  
15 computing device 1048 is illustrated as a portable computer that can include many  
16 or all of the elements and features described herein relative to computing device  
17 1002.

18 [0111] Logical connections between computing device 1002 and the remote  
19 computer 1048 are depicted as a local area network (LAN) 1050 and a general  
20 wide area network (WAN) 1052. Such networking environments are  
21 commonplace in offices, enterprise-wide computer networks, intranets, and the  
22 Internet. When implemented in a LAN networking environment, the computing  
23 device 1002 is connected to a local network 1050 via a network interface or  
24 adapter 1054. When implemented in a WAN networking environment, the  
25 computing device 1002 typically includes a modem 1056 or other means for

1 establishing communications over the wide network 1052. The modem 1056,  
2 which can be internal or external to computing device 1002, can be connected to  
3 the system bus 1008 via the input/output interfaces 1040 or other appropriate  
4 mechanisms. It is to be appreciated that the illustrated network connections are  
5 exemplary and that other means of establishing communication link(s) between the  
6 computing devices 1002 and 1048 can be employed.

7 [0112] In a networked environment, such as that illustrated with computing  
8 environment 1000, program modules depicted relative to the computing device  
9 1002, or portions thereof, may be stored in a remote memory storage device. By  
10 way of example, remote application programs 1058 reside on a memory device of  
11 remote computing device 1048. For purposes of illustration, application programs  
12 and other executable program components, such as the operating system, are  
13 illustrated herein as discrete blocks, although it is recognized that such programs  
14 and components reside at various times in different storage components of the  
15 computer system 1002, and are executed by the data processor(s) of the computer.

16 [0113] Although embodiments of the invention have been described in  
17 language specific to structural features and/or methods, it is to be understood that  
18 the invention defined in the appended claims is not necessarily limited to the  
19 specific features or methods described. Rather, the specific features and methods  
20 are disclosed as exemplary implementations of the claimed invention.

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